Name: KEY
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General Physics
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Kinematics

Use the Cross Country Course (Figure 1) and Cross Country Times (Table 1) for questions 1 - 6.

Table 1 - Cross Country Times (in Hours)

Runners	A	B	C	D	E	F	Total
1 Casey	.16	.13	.08	.11	.11	.25	.84
2 Vanessa	.17	.13	.08	.12	.12	.26	.88
3 Katie	.17	.14	.08	.13	.11	.24	.87
4 Kelly	.16	.14	.07	.11	.10	.25	.83

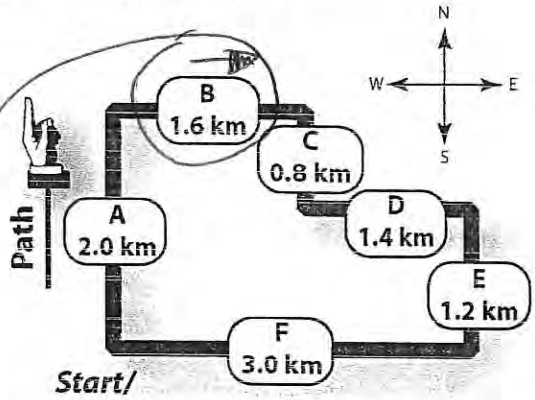

Figure 1
Cross Country Course

B 1. In **km**, what is the runners' **displacement** in leg B of the race?
a) 1.6 km b) 1.6 km East c) 2.0 km d) 2.0 km North
DISPLACEMENT IS A VECTOR

B 2. In **km**, what **distance** did the runners run if they completed the race?
a) 6.2 km b) 10 km c) 16.1 km d) 20 km
THIS IS THE TOTAL DISTANCE RUN 2.0 + 1.6 + .8 + 1.4 + 1.2 + 3.0

A 3. In **km**, what **displacement** did the runners run if they completed the race?
a) 0 km b) 10 km West c) 16.1 km South d) 20 km West
DISPLACEMENT ONLY DEALS WITH THE START & END POINTS; SINCE THEY ARE BOTH THE SAME THE ANSWER IS ZERO.

C 4. Which runner had the best **average speed** during last leg of the race (Leg F)?
a) Casey b) Vanessa c) Katie d) Kelly
KATIE COMPLETES THE LAST LEG (F) WITH THE QUICKEST TIME.

D 5 Which runner had the best **average speed** for the whole race ?
a) Casey b) Vanessa c) Katie d) Kelly
KELLY COMPLETES THE RACE WITH THE QUICKEST TIME. AND THEREFORE WINS THE RACE

D 6. Who won the race?
a) Casey b) Vanessa c) Katie d) Kelly

Use the Velocity - Time Graph (Figure 2) for questions 7 - 10.

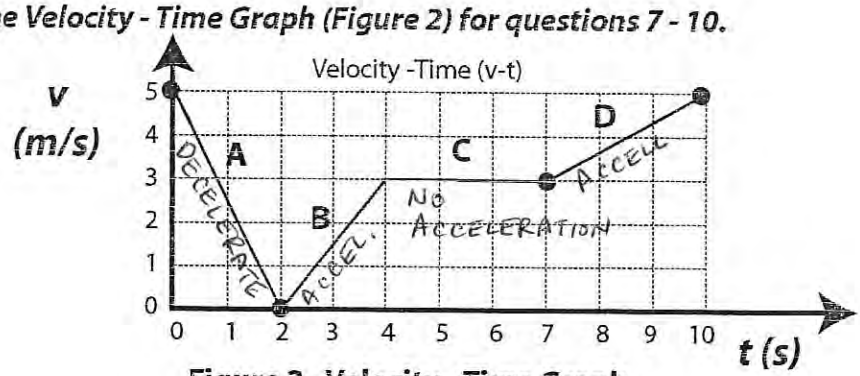

Figure 2 - Velocity - Time Graph

B 7. What was the **average velocity of leg A**?
a) 2 m/s b) 2.5 m/s c) 5 m/s d) 7 m/s

START Velocity = 5
+ END velocity = + 0
5 ÷ 2 POINTS
= 2.5 m/s

C 8. In which leg of the trip did the car have **no acceleration**?
a) A b) B c) C d) D

NO Δ IN V = NO ACCELERATION

A 9. In which leg of the trip did the car **decelerate**?
a) A b) B c) C d) D

LEG A HAS A (-) SLOPE

B 10. In which leg of the trip did the car have **the greatest acceleration**?
a) A b) B c) C d) D

THE SLOPE OF "B" IS GREATER THAN THAT OF "D"

Newton's Laws of Motion

Use Acceleration Due to Gravity (Table 2) for questions 11 - 14.

Table 2
Acceleration Due to Gravity

Planet	g (m/s²)
Mercury	3.6
Venus	8.9
Earth	9.8
Mars	3.8
Jupiter	26.0
Saturn	11.1
Uranus	10.7
Neptune	14.1

B 11. On May 25, 2008, the Phoenix Spacecraft landed on Mars. Choose the one item that was the same as that on earth.
a) Its weight b) Its mass c) Its temperature d) gravity

D THE MASS OF AN OBJECT DOES NOT CHANGE REGARDLESS OF LOCATION

12. In the 1970's two 885 kg Viking Rovers landed on Mars. What were the **combined weight** of both Rovers on **earth**?
a) 90.36 N b) 885 kg c) 8673 N d) 17,346 N

B $m = (2)(885k) = 1770\ kg$ $W = mg = (1770kg)(9.8\ m/s^2) = 5$

13. What was each Rover's **weight** on **Mars**?
a) 90.36 N b) 3363 N c) 885 N d) 8673 N

C $m = 885kg$ $g = 3.8\ m/s^2$ $w = mg = (885kg)(3.8\ m/s^2)$

14. What planet would the Rover have the **most weight**?
a) Mercury b) Earth c) Jupiter d) Neptune

JUPITER HAS THE HIGHEST "g" SO THE ROVER WILL HAVE GREATEST WEIGHT THERE.

D 15. A 400 kg hot air balloon is just beginning to be filled with air and is sitting on the ground. Which force is the balloon **NOT** experiencing at this point in time?
a) Normal Force (ON GROUND) b) Weight (ALWAYS) c) Lift Force (BEING FILLED) d) Friction Force (NOT NOW)

A 16. Since the hot air balloon is not moving at this point, its acceleration is zero. The sum of the forces on the hot air balloon is:
a) zero b) 0.5 N c) 400 N d) 3200 N

F = ma
IF a = 0 then F = 0

A 17. The balloon leaves the ground. Which force is the balloon **NOT** experiencing at this point in time?
a) Normal Force b) Weight c) Lift Force d) Drag Force

NOT ON GROUND NO (ALWAYS) (RISING) (YES)

B 18. What two items affect the Friction Force between two objects?
a) The Weight of the objects and the Temperature.
b) The Normal Force and the Coefficient of Friction between the two objects.
c) The Normal Force and the Acceleration.
d) The Normal Force and the direction it is pulled.

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Momentum

Use the Rolling Balls in Figure 3 for questions 19 - 21.

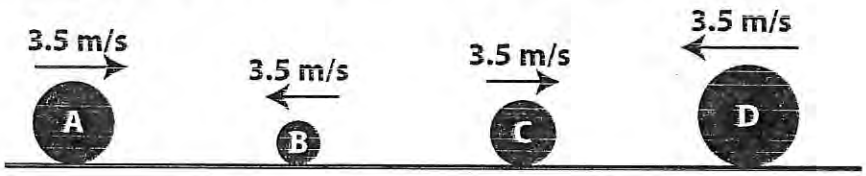


Figure 3 - Rolling Balls

D 19. If all of the balls in Figure 3 are solid and made-out of the same material, which one has the **most momentum**?
a) A b) B c) C d) D

$P = m v$

v IS SAME FOR ALL, THEN THE BALL WITH LARGEST MASS WILL HAVE MOST MOMENTUM

D 20. If Ball A has a mass of 10 kg, what is its **momentum**?
a) 0.35 kg-m/s Right
b) 3.5 kg-m/s Right
c) 10 kg-m/s Right
d) 35 kg-m/s Right

$P = m v = (10\,kg)(3.5\,m/s\,R)$
$P = 35\,kg\,m/s\,R$

C 21. If Ball B has a mass of 2 kg, how fast would it have to be moving to have the same momentum as to 10 kg Ball A moving at 3.5 m/s to the right?
a) 0.7 m/s Left
b) 1.75 m/s Left
c) 17.5 m/s Left
d) 35 m/s Left

$P_A = P_B$
$35\,kg\,m/s = m_B v_B = (2\,kg)(v_B)$
$v_B = \frac{35}{2}\,m/s = 17.5\,m/s$

Impulse

Use the following Data for questions 22 - 25

Cristiano Ronaldo kicks a 0.4 kg soccer ball with an impulse of 12 kg-m/s to the Right.

$m = .4\,kg$
$\Delta P = 12\,kg\,m/s\,R$
$F = 40\,N\,R$
$\Delta t = ?$

A 22. If he kicks the ball with a Force of 40 N to the Right, what is the **contact time** between his foot and the ball?
a) 0.3 s b) 0.6 s c) 3.3 s d) 33 s

$\Delta P = F \Delta t$
$12\,kg\,m/s\,R = (40\,N\,R)(\Delta t)$
$\Delta t = 12/40\,s$
$\Delta t = .3\,s$

C 23. If the ball was at rest, what is the **final velocity** of the ball?
a) 10 m/s Right b) 20 m/s Right c) 30 m/s Right d) 40 m/s Right

$\Delta P = m \Delta v$
$\Delta v = \frac{\Delta P}{m} = \frac{12\,kg\,m/s\,R}{.4\,kg}$
$\Delta v = 30\,m/s$

D 24. According to Newton's Third Law of Motion, what is the Force that the ball had on his foot? (Reference Question 22.)
a) 20 N Right b) 20 N Left c) 40 N Right d) 40 N Left
EQUAL FORCE BUT OPPOSITE DIRECTION

$\Delta v = v_f - v_i$
$v_f = 30\,m/s$

D 25. According to Newton's First Law of Motion, what Force causes the ball to eventually stop?
a) Friction Force between the ball and the grass yes
b) Drag Force between the ball and the air yes
c) Score Force between the net and the ball yes
d) All of the above

Collisions

Use the following directions for questions 26 - 30.

In the space provided, identify whether the following collisions are:
E - Elastic Collisions ***I*** - Inelastic Collisions

E 26. Hitting a tennis ball
E 27. Skimming a rock on a lake
E 28. Bumper Cars at Kennywood

CONTACT & BOUNCE APART

I 29. Snow Flake on the ground
I 30. An arrow into a target

CONTACT & STICK TOGETHER

Momentum - Impulse - Collisions

Use the following directions for questions 31-34.

In the space provided, identify whether the following statements are:
A - True ***B*** - False

A 31. Impulse and Momentum have the same units of measure.

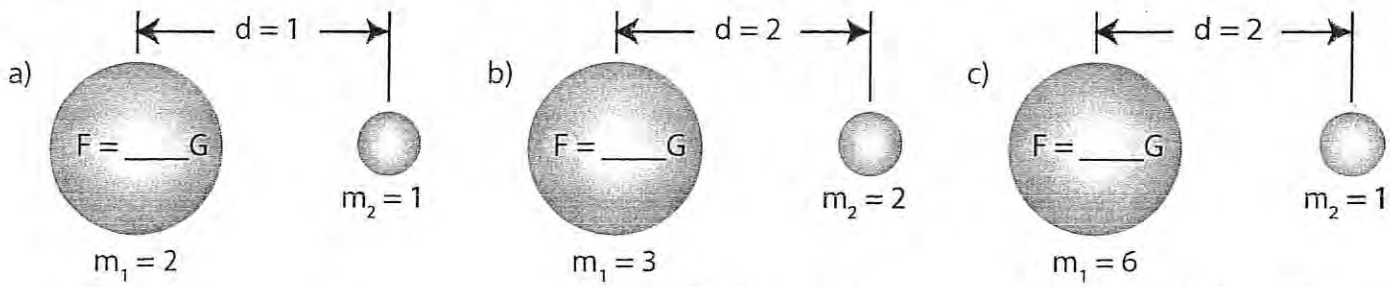
B 32. Conservation of Momentum means that the momentum *before* a collision is ~~***less than***~~ EQUAL TO the momentum *after* a collision.

A 33. New cars are safer for passengers due, in part, to the added contact time during a collision.

B 34. A train that is standing still has ~~a huge~~ NO momentum.

Circular Motion

A 35. Which planet pair has the greatest attractive Gravitational Force?



$F \propto \frac{m_1 m_2}{d^2}$ $\frac{2 \times 1}{1^2}$ 2N

$\frac{3 \times 2}{2^2} = \frac{6}{4}$ 4 1.5 N

$\frac{6 \times 1}{2^2} = \frac{6}{4}$ 1.5 N

Name: _____
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Circular Motion (continued)

A boy rotates a toy plane on a string as shown in Figure 4. Use this figure to answer Questions 36-38.

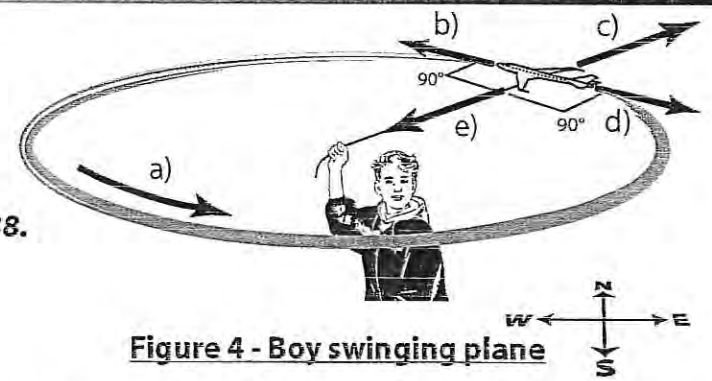

Figure 4 - Boy swinging plane

A 36. Which vector (arrow) represents the **angular velocity** (ω) of the plane? ROTATING VELOCITY

B 37. Which vector (arrow) represents the **tangential velocity (v_T)** of the plane? LINEAR VELOCITY IN DIRECTION OF ω.

E 38. Which vector (arrow) represents the **centripetal force** (F_c) of the plane? CENTER POINTING

Three Satellites are orbiting earth as shown in Figure 5.
Sat A and Sat B are in stable Low Earth Orbits (LEO).
Sat C is in a Geosynchronous Orbit.
Use this figure to answer Questions 39-44.

Note: All satellites have the same mass.

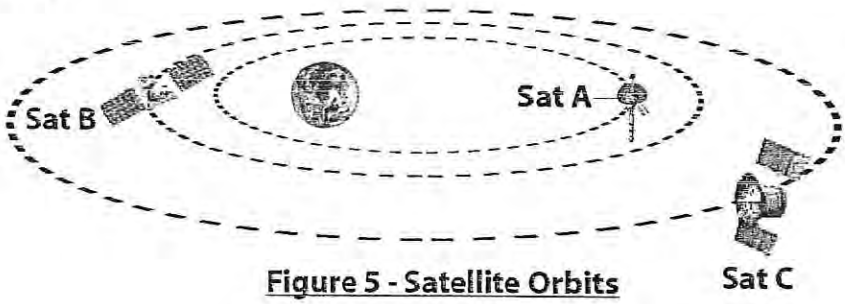

Figure 5 - Satellite Orbits

In the space provided write:
A for Sat A
B for Sat B
C for Sat C
S for all of the Satellites have the same

_____ 39. Which Satellite has the least **tangential velocity (v_T)**?

_____ 40. Which Satellite has the greatest **angular velocity** (ω)?

_____ 41. Which Satellite experiences the greatest **centripetal force (F_c)**?

_____ 42. Which Satellite has the greatest **Potential Energy (PE)**?

_____ 43. Which Satellite has the greatest **Kinetic Energy (KE)**?

_____ 44. Satellite C is in a Geosynchronous Orbit over the equator. This means:
a) The satellite will be in a different position in the sky every day.
b) The satellite makes one orbit around the earth in 12 hours.
c) The satellite makes one orbit around the earth in 24 hours.
d) The satellite makes one orbit around the earth in 48 hours.

m = 100 kg
W = mg = (100 kg)(9.8 m/s²) = 980 N ↓ = F ↑
WORK = Fd = (980 N)(1 m)
WORK = 980 J

d ↑ F ↓ W

Work - Power - Energy

D 45. Bob lifts a 100 kg box and walks 20 meters and places the box on a truck that is 1 meter high. How much **work** did Bob do on the Box?
a) 2000 J b) 2100 J c) 19,600 J d) 980 J

A 46. Bob takes a different 50 kg box from the truck and walks 500 meters to an office on the same level only to realize that he grabbed the wrong box. He then walks back to the truck and places the box back on the truck. How much work did he do?
a) zero b) 25,000 J c) 50,000 J d) 100,000 J

NO Δ IN HEIGHT OF BOX.

C 47. A 100 W motor lifts a 300 kg garage door in 8 seconds. How much **work** did the motor do on the garage door?
a) 12.5 J b) .33 J c) 800 J d) 2400 J

P = WORK/Δt
100 W = WORK/8 s
WORK = 100 W * 8 s = 800 J

C 48. If the owner wanted the garage door in question 47 to open in 4 seconds. The motor needs to be changed to a _____ motor.
a) 50 W b) 75 W c) 200 W d) not enough information

P = 800 J / 4 s = 200 W

D 49. A 2 kg toy helicopter is traveling 8 m/s at a height of 5 meters. What is its **Potential Energy**?
a) 16 J b) 20 J c) 50 J d) 98 J

PE = mgh = (2 kg)(9.8 m/s²)(5 m)
PE = 98 J

C A 50. What is the **Kinetic Energy** of the toy helicopter in question 49?
a) 8 J b) 16 J c) 64 J d) 98 J

KE = ½ mv² = (.5)(2 kg)(8 m/s)²

Use the Roller Coaster (Figure 6) for questions 51-53.

Note: All of the cars started at the top and have the same mass.

A 51. Which car has the most **Potential Energy**?
a) Car A b) Car B c) Car C
d) Car D e) All the same

HIGHEST "h"

B 52. Which Car has the most **Kinetic Energy**?
a) Car A b) Car B c) Car C
d) Car D e) All the same

CAR B'S POTENTIAL ENERGY IS CONVERTED TO KINETIC ENERGY

E 53. Neglecting friction losses, which Car has the most **Mechanical Energy**?
a) Car A b) Car B c) Car C
d) Car D e) All the same

ALL CARS WILL HAVE THE SAME ME = PE + KE

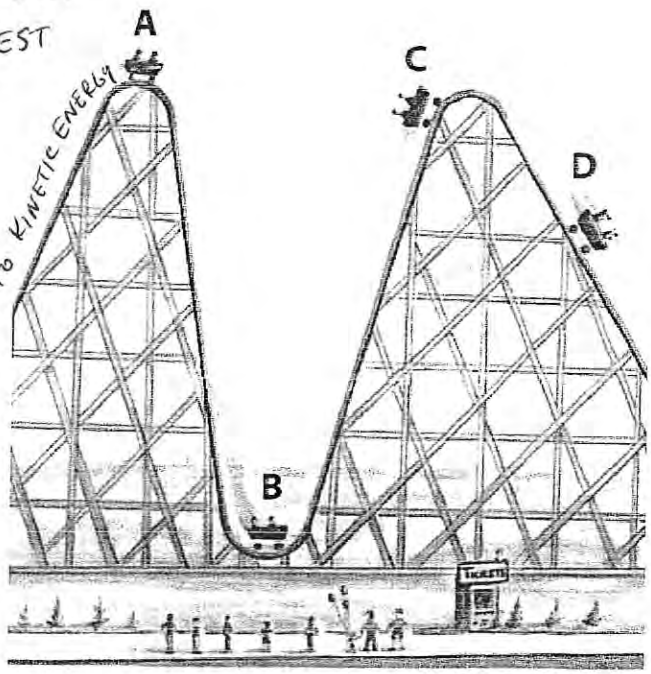

Figure 6 - Roller Coaster

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Basic Circuits

Use the circuit (Figure 7A) for questions 54-56.

D 54. What is the voltage of the battery?
a) 3.56 J b) 3.56 V
c) 18 J d) 18 V

$V = IR = (2.25\,A)(8\,\Omega) = 18\,V$

C 55. What is the Power of the circuit?
a) 8 W b) 8 J
c) 40.5 W d) 40.5 J

$P = IV = (2.25A)(18V) = 40.5\,W$

A 56. What **direction** will the current flow in the circuit?
a) Clock-wise (CW)
b) Counter-Clock-wise (CCW)

CURRENT FLOWS (−) to (+)

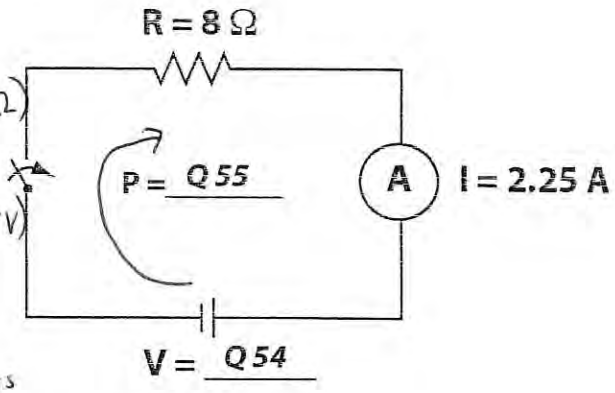

Figure 7A - Circuit

Use the circuit (Figure 7B) for questions 57-59.

B 57. What is the **Current** of the battery?
a) 4 J b) 4 A
c) 81 J d) 81 V

$V = IR$
$\frac{18\,V}{4.5\,\Omega} = \frac{(I)(4.5\,\Omega)}{4.5\,\Omega}$
$I = 4A$

C 58. What is the **Power** of the circuit?
a) 4.5 W b) 4.5 J
c) 72 W d) 72 J

$P = IV$
$(4A)(18\,V)$
$P = 72\,W$

B 59. What **direction** will the current flow in the circuit?
a) Clock-wise (CW)
b) Counter-Clock-wise (CCW)

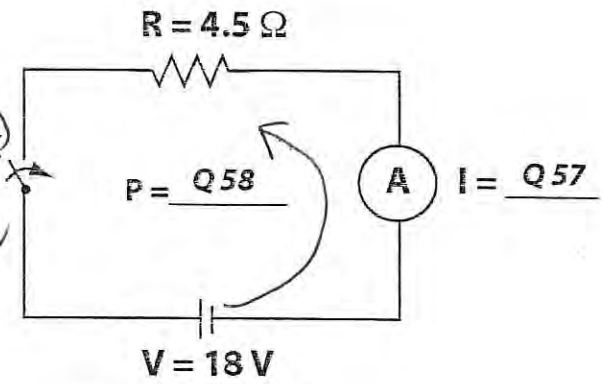

Figure 7B - Circuit

D 60. In a standard AAA battery, electron flow is produce by a(n) _____ reaction.
a) allergic b) mechanical c) nuclear d) chemical

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